WHAT IS CLAIMED IS:

1 1. A local area network (LAN) switching apparatus for

2 interconnecting a LAN segment to an Asynchronous Transfer Mode

3 (ATM) network, comprising:

4 a plurality of LAN ports, wherein each LAN port connects one

5 unique LAN segment to a LAN switch;

6 at least one ATM port, wherein each ATM port of the LAN switch

7 interfaces to the ATM network;

8 a connection means for establishing a plurality of connection

9 paths simultaneously, wherein each said connection path establishes

10 a connection through the switching apparatus between any two or

11 more of the plurality of LAN ports and ATM ports, said connection

12 path for transmitting data comprising LAN frames;

13 a data transmission means for formatting data for transmission

14 over said LAN into standard LAN frames in compliance with the

15 international standard of Open Systems Interconnection (OSI),

16 wherein said standard provides a universally applicable layered

17 architecture containing seven layers, numbered from 1 to 7, with

18 each layer having a set of defined functions and providing a set of

19 services to and from the adjacent two layers; and

20 a LAN to ATM format conversion means for changing the format

21 of data as it traverses the LAN switch from LAN port to switch to

22 ATM port, wherein LAN frames are converted to switch frames for

23 transfer through the switching apparatus and switch frames are

24 converted to ATM frames in preparation for transfer to the ATM

25 network;

26 an ATM adapting apparatus for converting ATM frames to ATM

27 network format and ATM network format to ATM frames, wherein ATM

28 network format comprises segmenting said ATM frame into sequential

29 ATM cells comprising 5 bytes of header and 48 bytes of data; and

30   a first multiprotocol processing means, wherein said LAN

31 switch converts either layer 2 or layer 3 of the OSI standard from

32 LAN frames to switch frames to ATM frames, wherein LAN frames are

33 compatible with LAN protocol and ATM frames are compatible with the

34 first ATM adapting apparatus protocol.

1   2.   The LAN switching apparatus of claim 1 further comprising:

2   an ATM to LAN format conversion means for changing the format

3 of data as it traverses the LAN switch from ATM port to switch to

4 LAN port, wherein ATM frames are converted to switch frames for

5 transfer through the switching apparatus and switch frames are

6 converted to LAN frames for transfer to the LAN port; and

7   a second multiprotocol processing means, wherein the LAN

8 switch converts either the layer 2 or layer 3 of the OSI standard

9 from ATM frames to switch frames to LAN frames.

3.   The LAN switching apparatus of claim 2, further comprising a

sorting means for the ATM port, wherein the ATM port sorts LAN

frames arriving from said switch connection path and ATM frames

arriving from the ATM network into three categories, comprising:

5   a first category of frames for routing, wherein layer 3 of the

6 OSI standard is converted from LAN frames to ATM frames, or layer

7 3 of the OSI standard is converted from ATM frame format to LAN

8 frame format;

9   a second category of frames for bridging, wherein layer 2 of

10 the OSI standard is converted from LAN frame format to ATM frame

11 format or layer 2 of the OSI standard is converted from ATM frame

12 format to LAN frame format; and

13   a third category of frames for aborting, wherein LAN frames or

14 ATM frames are erroneous and cannot be routed or bridged.

1   4.   The LAN switching apparatus of claim 3 wherein the ATM port

2 further comprises a hardware forwarding means for bridging frames

3 from switch frame format to ATM frame format, or from ATM frame

4 format to switch frame format, said bridging without requiring

5 processor intervention.

1   5.   The LAN switching apparatus of claim 4 wherein the ATM port

2 further comprises a routing processor means for routing switch

3 frames and routing ATM frames under software control.

1   6.   The LAN switching apparatus of claim 5 wherein the sorting

2 means further comprises a single ported frame memory comprising:

3   a hardware transmit queue for temporarily storing switch

4 frames in transit between the switch and the ATM adapting apparatus

5 for subsequent accessing by the hardware forwarding means for

6 bridging switch frames to ATM frames;

7   a software transmit queue for temporarily storing switch

8 frames in transit between the switch and the ATM adapting apparatus

9 for subsequent accessing by the routing processor means for routing

10 under software control switch frames to ATM frames;

11   a hardware receive queue for temporarily storing ATM frames in

12 transit between the ATM adapting apparatus and the switch for

13 subsequent accessing by the hardware forwarding means for bridging

14 ATM frames to switch frames;

15   a software receive queue for temporarily storing ATM frames in
16 transit between the ATM adapting apparatus and the switch for
17 subsequent accessing by the routing processor means for routing
18 under software control ATM frames to switch frames; and
19   a set of conversion tables for assisting the hardware
20 forwarding means for converting switch frames to ATM frames and ATM
21 frames to switch frames.

1   7.   The LAN switching apparatus of claim 6 wherein the sorting
2   means operates such that frames of the first category are stored to
3   the software transmit queue, frames of the second category are
4   stored to the hardware transmit queue, and frames of the third
5   category are discarded.

8   8.   The LAN switching apparatus of claim 7 wherein the hardware
    forwarding means further comprises an ATM formatting means for
    generating an ATM frame format, comprising the LAN frame prefixed
    with an ATM control header, the ATM control header comprising:
         a virtual channel connection field for defining the connection
    route through the ATM network; and
         a LAN emulation header for identify unique LAN frames for
    carrying control information.

1   9.   The LAN hardware switching apparatus of claim 8 wherein the
2   hardware forwarding means further comprises a LAN formatting means
3   for generating a switch frame format, comprising the LAN frame
4   prefixed with a switch header, the switch header comprising:
5   a tag field for specifying the address of the conversion table
6   entry for access by the hardware forwarding means from the frame

7   memory to obtain the conversion parameters to ATM frame format,

8   comprising the virtual channel connection field and the LAN

9   emulation header;

10   a frame type field for characteristics of the switch frame,

11 and an exit port definition field for defining to the connection

12 means which switch port is the destination of the switch frame.

1   10.   The LAN switching apparatus of claim 9 wherein the hardware

2   forwarding means further comprises a hardware format converter for

3   converting switch frames to ATM frames by replacing the switch

4   header with the ATM control header.

1   11.   The LAN switching apparatus of claim 10 wherein the hardware

2   forwarding means addresses the conversion tables in frame memory

3   using the tag field of the switch header to access the ATM control

4   header, whereupon the switch header is destroyed and the ATM

5   control header is accessed from the conversion tables and prefixed

6   to the LAN frame.

1   12.   The LAN switching apparatus of claim 11, further comprising an

2   ATM memory queuing means, wherein ATM frames are temporarily stored

3   before being segmented and transmitted to the ATM network or after

4   being received and reassembled from the ATM network.

1   13.   The LAN switching apparatus of claim 9 wherein the hardware

2   forwarding means further comprises ATM enqueuing means, wherein the

3   ATM enqueuing means requests a queue from ATM memory queuing means,

4   when the request is granted, sends the ATM frame to ATM memory

5   queuing means from the hardware transmit queue in frame memory,

6   erases the ATM frame from hardware transmit queue, and signals ATM

7   adapting apparatus to segment and transmit the ATM frame.

1   14.   The LAN switching apparatus of claim 13 wherein the sorting

2   means further comprises an exit port destination field of the

3   switch header including a first binary bit value for defining

4   frames to be routed and a second binary bit value for defining

5   frames to be bridged.

1   15.   The LAN switching apparatus of claim 14 wherein the sorting

2   means sorts frames such that frames of the first category are

3   stored to the software receive queue, frames of the second category

4   are stored to the hardware receive queue, and frames of the third

5   category are discarded.

1   16.   The LAN switching apparatus of claim 15 wherein the hardware

2   forwarding means further comprises a virtual LAN number for

3   identifying the ATM frame, wherein the virtual channel connection

4   field of the ATM control header is used to address the conversion

5   tables and access a virtual LAN number.

1   17.   The LAN switching apparatus of claim 16 wherein the hardware

2   forwarding means further comprises a virtual LAN filtering means

3   for determining whether the ATM frame arriving from the ATM network

4   is to be bridged to the LAN or discarded.

1   18.   The LAN switching apparatus of claim 17 wherein the virtual

2   LAN number and Destination MAC Address of the ATM frame is used to

3   address the conversion tables and access a valid or invalid

4   destination switch header, wherein frames having a valid

5   destination switch header are bridged and frames not having a valid

6   destination switch header are discarded.

1   19.   The LAN switching apparatus of claim 18 wherein the hardware

2   forwarding means further comprises an ATM to switch conversion

3   means for converting ATM frames to switch frames by replacing the

4   ATM control header with the switch header.

1   20.   The LAN switching apparatus of claim 19 wherein the said ATM

2   control header is destroyed and the switch header is generated from

3   the valid switch destination address and frame type field accessed

4   from conversion tables and the switch header is prefixed to the LAN

5   frame.

1   21.   The LAN switching apparatus of claim 20 wherein the virtual

2   channel connection field of the ATM control header includes a first

3   binary value for defining frames to be routed and a second binary

4   value for defining frames to be bridged.

22. A format converter comprised only of hardware for bridging frames from a first frame format to a second frame format, said bridging without requiring processor intervention.

1   23. A message frame sorter for sorting first type and second type
2   frames based on destination address to a first queue and a second
3   queue, wherein first types frames are stored in said first queue
4   and second type frames are stored in said second queue.

1   24.   A bridging apparatus comprised only of hardware for converting

2   and forwarding frames having a first frame format to frames having

3   a second frame format, said conversion without requiring processor

4   intervention.

1   25.   The bridging apparatus of claim 24, further comprised of

2   conversion tables for assisting in said converting and forwarding

3   of frames.

1   26. A protocol adaption apparatus comprised only of hardware for

2   converting and forwarding frames having a first protocol to frames

3   having a second protocol, said conversion without requiring

4   processor intervention.

1 27. A LAN emulation system comprising:

2   a plurality a local area networks (LANs);

3   an ATM network;

4   a plurality of LAN switches for interconnecting LANs and ATM

5 networks;

6   a controlling processor; and

7   a LAN emulation means, wherein communications in the form of

8 frames are transmitted from a first LAN to the LAN switch to the

9 ATM network to the LAN switch to a second LAN.

28. The LAN emulation system of claim 27 wherein the LAN emulation
means further comprises LAN emulation control hardware for
presetting LAN switch controls in advance of the frame transmission
for controlling the ATM network to function like a LAN when
transporting frames from LANs to ATM or ATM to LANs.

29. The LAN emulation system of claim 28 wherein the LAN emulation
means further comprises a LAN emulation header means for
identifying frames having information for presetting the LAN
emulation control hardware.

1 30. The LAN emulation system of claim 29 wherein the LAN emulation

2 control hardware further comprises a plurality of registers for

3 storing LAN emulation headers, wherein each register contains a

4 unique LAN emulation header data pattern.

1 31. The LAN emulation system of claim 30 wherein the plurality of

2 registers specify the set of LAN emulation headers that contain

3 information for presetting the LAN emulation control hardware.

1   32.   The LAN emulation system of claim 30 wherein the LAN emulation
2   means further comprises a LAN emulation control sorting means for
3   checking each LAN emulation header arriving from the ATM network to
4   determine if the LAN emulation header matches any of the prestored
5   plurality of LAN emulation headers in the registers and contains
6   information for presetting the LAN emulation control hardware.

1   33.   The LAN emulation system of claim 32 wherein the LAN emulation
2   means further comprises a forwarding means, wherein frames arriving
3   from the ATM network containing information for presetting the LAN
4   emulation control hardware are sent to the controlling processor to
5   be processed.